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ABSTRACT

Summaries of recent research have found computer-assisted instruction to be a highly motivating method of instruction that fosters independent study and provides for the immediate feedback necessary for the encouragement of individualized learning. A nonexperimental study was conducted with fourth, fifth, and sixth grade students (n=88) in a Chicago public elementary school who were from 1 to 2.5 years behind in their mathematics achievement scores. The students were from a wide variety of ethnic groups with over 80% of the students speaking English as a Second Language. These students visited a computer laboratory once per week for a 40-minute period and received an individually prescribed learning packet of computer-assisted programs. The results from these students' end-of-the-year mathematics achievement tests indicated significant gains in their scores. Further, there appeared to be a positive relationship between the performance of these students on the achievement test and their mathematical conceptual performance in their prescribed learning participation within the computer-assisted instructional program. (JJK)

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Computer Assisted Mathematics Prescription Learning Pull-out Program in an Elementary School

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ABSTRACT

This study involved 4th, 5th, and 6th graders who were one to two and a half years behind in their math scores in a Chicago Public Elementary School during the school year 1990-91. Students were from a wide variety of ethnic groups with over 80% of the students speaking English as a second language. The pull-out students (only students from these grades with low math scores) came to the computer laboratory once a week for a 40 minute period where they received a prescribed learning packet of computer assisted programs. While this was not a strictly controlled study per se (no experimental/control group situation), the results gleaned from the students' end-of-the-year math scores showed significant gains in their understanding of mathematical concepts. Classroom teachers involved with these students and the experimental program applauded the experimental program and felt it was an asset for these children. From this study, a controlled study is currently ongoing in the same school. In summary, there appeared to be a positive relationship between the performance of students in areas of mathematics and mathematical conceptual performance with their participation in a computer assisted prescribed learning instructional program.

COMPUTER ASSISTED MATHEMATICS PRESCRIPTION LEARNING PULL-OUT PROGRAM IN AN ELEMENTARY SCHOOL

RESEARCH

It is not surprising to note that computers are rapidly becoming an important factor in education. The computer provides a different way of teaching existing topics to children - often times in a more exciting manner. Many times students react in a more exciting way when using the computer to accomplish the same skills that they would be forced to do via a paper and pencil arrangement. It is felt among educators that the computer's presence in the schools forces educators to consider what is taught, how it is taught, and why it is taught, (Day, 1987). To this end, computer assisted instruction is only one aspect of a multi-faceted methodology designed to teach children certain subject skills. The computer is neither a complete instructor, nor will it replace the classroom teacher, as many had feared, but is a paramount learning tool in the public schools because of its availability.

Computer assisted instruction in education, as a relatively new phenomenon, has made great advances in the last two decades as a learning assisted teaching machine. In the beginning of the 1980's, Cox and Berger (1981) found that students who use computer assisted programs with microcomputers showed positive growth in their attitudes toward school work, self-control, and tasks which involved problem-solving skills. They further found that students were able to grow educationally, and were nonthreatened by the use of the microcomputer and accompanying software packages. This still holds true today.

There is cumulative evidence and research that computers appear to provide an effective means of improving performance in all subject areas. A growing number of research articles are related to the area of mathematics. Mathematics seems to be a difficult area for some children, and they need all the extra help they can be given. Many of the research articles are related to computer assisted instruction in the teaching of mathematics to students who are below grade level in their achievement of mathematical skills.

Bradtmueller (1983) summarized the research from 1975 to 1983 regarding the advantages of computer assisted instruction to students. He found computer assisted instruction to be highly motivating and encouraging, fostering independent study, providing immediate feedback and encouraging individualization. This research has held true for the effects of computer assisted instruction today with students.

Today's computers and accompanying software assist in instruction, serve as calculators, do clerical tasks for students, and even permit the student to program his/her own programs. Computers allow students to work at their own pace with programs that have been prescribed for them. The students appear to show positive results in the gaining of knowledge that they had either missed or did not understand in a regular classroom situation.

In the area of mathematics, simulations of mathematical events, previously impossible to comprehend by many students, are made simple and easy for the students to understand. These types of programs exist for all levels of curricular subjects. Simulations allow the students to carry with them a visual image of how something is done and how to accomplish a specific task. Student reinforcement of drill and practice programs in mathematics is handled in a very sophisticated way using the computers. Students are not forced to do mathematical problems via the paper and pencil, ditto sheet method and by using the computer for the same task. They are given immediate feedback and also many times an explanation of the math problems should be done. The motivation factor comes into focus here, too, as students are more highly motivated to do computer work, for the most part, than traditional paper and pencil type exercises.

Several research studies related to the growth in mathematical ability have been done. One such study used subjects in 3rd, 4th, and 5th grades from two lower socio-economic area schools in Louisiana and showed that these children with one to one and a half years below level in mathematics scores gained significantly in their mathematics using computer assisted instruction programs, (Hotard, 1983). Another study that used the same grade levels of students, this time in Washington, showed students who participated in a computer assisted mathematics program were consistently and significantly higher in their mathematical ability than children who had other traditional classroom related math treatments. (McConnell, 1984).

A Los Angeles study (Ragosta, 1983) was an intensive study that involved students from six elementary schools. These students participated in mathematical computer assisted instruction programs. The end result of this extensive study showed that students of all grade levels benefitted from the computer assisted mathematics curriculum given them by their teachers. The teachers of these students also credited the program with long-term higher test scores in the area of mathematics. The standardized tests given these students bore this out.

Another study done by Gourget, 1987, involved students in grades four to eight in the Newark, New Jersey Public Schools. Students in this study were mostly low income students, and many of them spoke English as a second language. These students received computer assisted instruction in mathematics programs via drill and practice type programming in software in

a pull-out classroom computer program. The gains these computer assisted instruction students received in mathematics were significant gains that were made by subject students. Students receiving computer assisted instruction in mathematics with coordinated classroom instruction made greater achievement gains.

But, the important aspect here is that the computer assisted instructional programs aided the students in their comprehension and achievement in the area of mathematical skills.

In conclusion, students at all grade levels benefitted from the computer assisted programs designed to improve their skills in mathematics. Computer assisted programming for students in mathematics led to a significant positive gain on their standardized test scores. Results imply that this type of computerized instruction designed and planned to aid students in improving their test scores in the area of mathematics works positively. Computer assisted instruction appeared to improve the learning and reinforcement of math skills, as is evidenced by the positive gain on standardized test scores. Thus, a computer assisted instructional program that is a pull-out program from the regular classroom seems to have benefitted the students, by not only raising their test scores, but in some cases, accelerating their grade level test scores. The results of these studiles imply that children can achieve greater gains in total math skills by utilizing computer assisted instruction software packages.

PURPOSE OF THIS STUDY

The purpose of this study was to experiment with below level students (in the area of mathematics) with the use of computer assisted instruction to improve their mathematics scores. These students selected for this study did not particularly like mathematics and all were below grade level in their mathematical scores on their standardized tests. The computer teacher in the school and myself, a university professor teaching microcomputer skills in a Master's degree program, collaborated and devised a program where the students were identified, and prescribed computer assisted instruction software programs to help them to have a better conceptual framework of mathematics.

SUBJECTS:

Subjects were students in the 4th, 5th, and 6th grades from a Chicago Public Elementary School that participated in this study. The study took place during the 1990-91 academic school year. The socio-economic level of the school is mixed. The students come from a wide range of ethnic backgrounds, with no single ethnic background predominating. 80% of the subject students spoke another language other than English. The grade

level of the subjects is broken down as follows: 4th grade = 17 males, 10 females; 5th grade = 19 males, 12 females; 6th grade = 17 males, 13 females. All subject students who participated in this study were at least one year to two and one-half years below grade level ability in mathematics, according to their Iowa tests of basic skills. Many of the students were also below level in their reading skills, but not as drastically as their below-level mathematics scores.

PROCEDURES:

Students who participated in this study were pulled from the 4th, 5th, and 6th grades on the basis of their low level mathematics scores. They were kept together as a class of 4th, 5th, and 6th graders. All students received computer assisted mathematics programs for one 40-minute period per week. They came to the computer laboratory as a group and received instruction via computer software programs designed appropriately for their specific level, and additional instruction from the computer teacher. These students were given an individualized computer assisted program that was designed to (over the school year) improve and accelerate their present mathematical skills. The programs used were pre-designed mathematics programs from reputable software vendors. These programs were previewed and reviewed by the computer teacher and the writer of this paper and assigned to the students in the class where it was determined they would be utilized with the best results for the individual student. The combination of varied computer assisted instructional programs - drill and practice, puzzles and problem-solving, simulation and educational game programs were designed to teach and aid the students in varied mathematical concepts, reinforce basic mathematics skills, and to keep their interest level from waning with the resultant hating of mathematics. The level of software classifications and computer activities was correlated as much as possible with ongoing classroom activities in the same instructional areas. The microcomputer and classroom experiences were comparables in that both incorporated paractice in the use of single math concepts and both were educationally appropriate for the age and ability levels of the sample students. Many of the computer software programs were such that the student could adjust the programs to his/her level of ability and proficiency. These pull-out, with reinforcement, students were given an intense 40-minute session each week. The students could also come to the computer laboratory during recess and lunch times and before school to work on their prescribed learning packages.

Students were tested each fall and spring with standardized tests. Students were also tested throughout the course of the school year with individualized tests, designed by the computer teacher. The content of the tests was taken from the computer assisted instructional software that the students had been using over the course of the school year in different subject segments.

FINDINGS OF THIS STUDY:

The gains made by the students in the pull-out computer assisted mathematics instructional program were above average. 'Though not very strictly controlled, as in a control/experimental group setting, the data gleaned from test scores from previous years of the sample students showed appreciably more positive mathematics score gains. Gain scores of the computer mathematics program were higher with individual teacher-designed testing than proportionate standardized test scores. However, there was not a comparison group with which to compare this experimental pull-out mathematics program experiment. But these children in the 4th, 5th, and 6th grades were one to two and one-half or more years behind in mathematical skills when they began the program, and they certainly made meaningful progress in mathematical concepts. There was strong evidence in the classroom performance of these subject children in mathematics-related abilities over the school year. An aspect of this study that couldn't be measured via testing was that of motivation. In the beginning these children vehemently disliked mathematics and any math-related activities. But, by careful interspersement of computerized math games, students actually came to enthusiastically enjoy their weekly time in the computer lab working on the diversified mathematics programs. They became so enthused that they had their own program to follow that one would see many of these students in the computer lab before school, during lunch periods, etc. working on "their" programs. These programs were put on a shelf and only those students who participated in this study could use their pre-designed, prescribed programs.

The students did learn many mathematical concepts in which they had been weak and, although it was not something that was set out to be measured, it was felt by many of the students' teachers that their reading abilities had been helped immensely, since many of the mathematical computer software programs had problem-solving problems that the students had to read to solve.

LIMITATIONS OF THE STUDY:

This study was begun as an experiment. A follow-up study is in progress using specific standardized tests and specific computer software designed packages. Commercial software packages did not always fit the specific needs of the students, and had to be written and designed. This proved to be very cumbersome and time-consuming. Another limitation of the study was that students were not identified early enough in the school year, and students were added to the program as they were admitted to the school - some as late as mid-year. A more serious limitation was that there was no specific means of assessing their gain - via a standardized test mechanism. Mathematical gains were assessed using teacher prepared tests.

However, the Iowa test of basic skills was used as an ending test, and gains of the students showed positive and significant enough in the area of mathematics that the study was deemed to be successful.

CONCLUSIONS:

The program, loosely constructed in the beginning, was a huge success. The teachers of the students involved in this study stated they felt their students seemed to greatly improve upon their mathematics skills and math abilities. In the beginning the individual computer assisted prescription learning programs that were designed for each student were on a trial and error basis. But, as the year progressed, specific learning software packages were assigned to students. There is presently an ongoing study in this school that is the outgrowth of the initial study. The current study is more controlled, more structured, and specific software packages are being utilized with the children. The conclusion of this study showed that students did benefit from this type of computer assisted instructional program in the area of mathematics and did exhibit significant gains in their test scores in math.

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